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ATTACHMENT 7. ECONOMIC ANALYSIS – FLOOD DAMAGE REDUCTION COSTS AND BENEFITS

Copeland Creek Enhancement and Restoration Project: Detention and Recharge Basins
Sonoma County Water Agency

Attachments to this Section:

- FRAM Model
- Tables 6, 10, and 12

The basis for the estimating the economic flood damage benefits is calculated utilizing the FRAM model's event-based analysis for the 100-yr (1%), 50-yr (2%), and 10-yr (10%) recurrence probability events. The assessment of flooding damage (impacted properties) is predominantly based on, or derived from, observations qualitatively described and/or documented by the City of Rohnert Park (City) for significant flooding events that occurred December 31, 2005 and January 2008, and flooding events known to occur with more frequent regularity. Flooding from the 2005 and 2008 flood events were estimated to be closely representative of 100-yr and 50-yr events, respectively, while flooding known to occur more frequently was assumed to be representative of 10-yr event conditions.

The City's estimate of the number of impacted properties for those known flood events was evaluated by the Sonoma County Water Agency's (Water Agency) drainage review section to establish estimates of flood reduction benefits (number of flood impacted properties) under the "with-project" condition. Those estimates presumed that the project will re-establish the original channel design condition of containing the 100-yr peak stream flow within the Copeland Creek flood control channel, thereby eliminating overtopping break-out flows that contribute to urban flooding in the Copeland Creek watershed and adjacent Hinebaugh Creek watershed.

The existing flooding conditions to be alleviated by restoring flood channel containment of 100-yr storm runoff event is estimated to benefit and reduce flooding impacts to several significant local transportation corridors (Rohnert Park Expressway, Snyder Lane, Commerce Boulevard), local roadways, residential, commercial, and industrial properties, schools (Sonoma State University, Rancho Cotate High School), and emergency services.

The flood hazard reduction benefits of the project's stormwater detention basins will primarily be realized within the Copeland Creek watershed, but only incremental to negligible flood reduction benefits are anticipated to be realized by downstream receiving waters (Laguna De Santa Rosa to Russian River) which discharge to the Pacific Ocean. Hinebaugh Creek will also realize flood hazard reduction benefits break-out flows from Copeland Creek no longer occur.

Flood hazard reduction benefits will be received upon completed construction of the project in 2014.

Input data for the FRAM model is based on the following assumptions/data:

Cost of Project: $9,388,341 excludes project costs not directly attributable to flood hazard reduction provided by the detention storage (e.g. trail, habitat restoration, etc.).

Number of Events Modeled: three (100-yr, 50-yr, and 10-yr events based on City of Rohnert Park flood impact estimates).

Probability of Levee Failure: No flood control structures present, assumed a value of "1" per FRAM model's instructions.

Flood Experience: Based on information provided by the City 50-yr and 10-yr flood events were observed within the last 5 years, but no 100 year events were observed in that time period. Therefore, a Flood Experience value of "Y" was input for 50-yr and 10-yr flood events and a Flood Experience value of "N" was input for the 100 year event.

RESIDENTIAL PROPERTIES

Ratio Depreciated Value to Replacement Value: Mean residential building age of 30 years was provided by the City. From Figure 14.2 of Hazus –MH MR5 Technical Manual, the mean depreciation of residential properties 30 years old is 30%. The relationship between depreciated value (DV) and replacement value (RV) is calculated as "DV = 0.7RV." Therefore, the Ratio of DV to RV (DV/RV) is equal to 0.7, or 70%.

Average Flood depth above ground level: From photos and information provided from the City, existing conditions of Average Flood Depth is assumed to be 10 in, 8 in, and 6 in for the 100, 50 and 10 year events respectively. Average Flood Depth after implementation is assumed to be alleviated by 10% per event for properties still impacted after project implementation. Therefore, input values for Average Flood Depth "With Project" are 0.75 ft, 0.60 ft and 0.45 ft for the 100, 50 and 10 year events respectively.

Urban Res- Single Story (no base): Existing conditions of number of Single Family homes inundated was provided from the City. Information was provided in the form of Single Family Homes for the 100, 50 and 10 year events respectively. Conversion of Single Family Homes to Single Story Properties and Multiple Story Properties is based on conversion factors from Table 3.6 of FEMA's Hazus –MH MR5 Technical Manual. Per Table 3.6, ⅓ of Single Family Homes are Multiple Story Properties and ⅔ are Single Story Properties. Single Story Properties inundated "With Project" based on review by the Water Agency.

Urban Res- Two plus story (no base): Existing conditions of number of multifamily dwellings (MFD) inundated from the City. Information was provided in the form of MFDs for the 100, 50 and 10 year events. Conversion of MFD to Single Story Properties (no base) and Multi Story Properties (no base) was performed by utilizing the population per household from City US Census Bureau data, the F-RAM model's assumed value of population per residential property and Google Maps Street View. From the US Census Bureau, the City has an average population per household of 2.65. This was multiplied by the number of MFD to calculate the project's "population." This was then divided by the F-RAM model's average population per residential property of 2.6 to arrive at an equivalent number of multifamily properties. To finish the conversion of MFD to Single Story Properties and Multi Story Properties, 95% of multifamily properties are assumed to be multistory properties and the remaining 5% are assumed to be single story properties based on a review using Google Maps Street View.

Mobile Home: Existing conditions of number of Mobile Homes inundated from City. Mobile Homes inundated "With Project" based on review by the Water Agency.

COMMERCIAL and INDUSTRIAL PROPERTIES

Ratio Depreciated Value to Replacement Value: Mean commercial and industrial building age of 25 years provided by City. Figure 14.3 of Hazus –MH MR5 Technical Manual shows the mean depreciation of commercial and industrial buildings 25 years old is 30%. The relationship between DV and RV is calculated as "DV = 0.7RV." Therefore, DV/RV is equal to 0.7, or 70%.

Average Flood depth above ground level: From photos and information provided by City, existing conditions described flood damages for the 100 year event (6 inches inside industrial buildings), but not for the 50 and 10 year. To capture these conditions in the F-RAM, Average Flood depths were assumed to be 1.5 ft, 1.2 ft, and 0.9 ft for the 100, 50 and 10 year events respectively. The change in Average Flood depths was based on the assumption that there is a 0.3 ft reduction in depth between each event. Flood depths after implementation of project were assumed to have a marginal impact reducing flood depths by 10% per event for properties still impacted after project implementation.

Medium value building area inundated (sq.f.): Existing conditions from City. Commercial properties were assumed to be of medium value. Area inundated "With Project" based on review by Water Agency.

ROADS

Length of roads inundated: Existing conditions from City. Length inundated "With Project" based on review by Water Agency.

Copeland Creek Enhancement and Restoration Project: Detention and Recharge Basins
Sonoma County Water Agency

Project Benefits Worksheet					
Benefit Type	Benefit Amount	Unit of Measure	Economic Unit	Water Body	303d yes/no
Sediment Reduction	Flood storage and conveyance sufficient to protect the surrounding community from the damages associated with the one in one hundred year flood. See Avoided Costs for Benefit Amount.	See Avoided Costs	See Avoided Costs	Copeland Creek	Yes
Habitat Restoration, Invasive Plant Removal, and Improved Fish Passage	• 6,600 lineal feet of high quality riparian corridor with a diversity of canopy tiers to provide fish, invertebrate and wildlife habitat. • Improved water quality functions: for average and greater magnitude flows, as well as, sediment collection and storage; nutrient uptake and conversion and bacterial reduction • Flood storage and conveyance sufficient to protect the surrounding community from the damages associated with the one in one hundred year flood. • Riparian corridor bird habitat and bird watching for hikers who use the creekside trail. • Riparian corridor and floodplain improvements reduce impaired sediment and nutrient conditions downstream in the Laguna de Santa Rosa	1.25 Stream miles (6,600 linear feet) of riparian habitat; 10 acres of non-native invasive shrubs and trees restored by strategically removing exotics and replanting with 2,700 plants. Assumes value of one acre of restored habitat is $3,880	Water quality control value estimated at $6,700/hectare /year; improved recreation estimated at $3,000/hectare /year (PAY – IUCN, Gland, Switzerland)	Copeland Creek	Yes

Copeland Creek Enhancement and Restoration Project: Detention and Recharge Basins
Sonoma County Water Agency

Project Benefits Worksheet					
Benefit Type	Benefit Amount	Unit of Measure	Economic Unit	Water Body	303d yes/no
	• Improved passage and outmigration conditions for Threatened steelhead. $38,800				
Increased Water Supply/ Reliability	$45,000	75 acre-feet/year	$600 /acre-foot (wholesale water rate)	Copeland Creek	Yes
Environmental Benefit of base flow supply to the stream	$5,625	75 acre-feet/year	$75/acre-foot[1]	Copeland Creek	Yes
Flood Control and Increased Storm Water Detention	Present Value of Future Benefits: $13,677,400 Net Present Value: $4,289,059 Benefit Cost Ratio: 1.457 Annual Benefit: $867,753	100 year flood protection for Rohnert Park	Based on FRAM storm water model with property estimates from previous flood observations	Copeland Creek	Yes

1. The literature suggests that agricultural water use has a value of $53 per acre-foot, municipal water use has a value of $112 per acre-foot, and water left instream for environmental purposes, including salmonid habitat, has a value of $75 per acre-foot (Brown 2007)

Avoided Costs of Future Projects Worksheet				
Avoided Cost Type	**Avoided Cost Amount**	**Unit of Measure**	**Economic Unit**	**Avoided Cost Description**
Construction of conveyance capacity upgrades (e.g. culverts, storm drains, etc.)	$1 million	Difference between conveyance upgrades and detention basins	Engineer's estimate	Based on the cost of conveyance upgrades within the Copeland Creek Watershed, detention basins are the most cost effective method of providing 100 year flood protection for Rohnert Park's downstream urban area
Future sediment removal and vegetation management	$20,000/year	Reduction in current budgeted costs; focused sediment reduction at a rate of 2,000 cubic yards per year will reduce cost by approximately $5/cubic yard with much reduced environmental damage	Budget estimate; Reduced cost/cubic yard with focused approach	Decrease in operational costs associated with in-stream sediment removal and vegetation management based on historical costs

Project Benefit Narrative Table						
Benefit Type	Beneficiary	When Benefits will be Received	Estimates of Without-Project Conditions	Estimates of With-Project Conditions	Description of Methods Used to Estimate	Other: Adverse Effects, Uncertainty of the Benefits, Statewide Benefits
Flood Control (Hazard Reduction) and Increased Storm Water Detention	Rohnert Park & Sonoma County Water Agency	2015	Continued flooding of Rohnert Park properties and structures with accompanying risks to life and properties and impact on transportation corridors	Upon construction of detention basins will achieve flood control within 100 year storm limits	Preliminary engineering analysis of project alternatives (to contain 100-yr flows within channel) versus qualitative assessment of existing flooding conditions	
Increased Water Supply/Reliability and Environmental Benefit of base flow supply to the stream	Rohnert Park & Sonoma County Water Agency	2014	Continued reliance on imported water and reduced groundwater recharge potential	Increase aquifer recharge, decrease reliance on imported water, increase base flow to the stream with estimated benefits of $5,625 to $45,000 per year.	Cost/acre foot of water	Requires geotechnical and design studies to determine recharge capacity of soils
Sediment Reduction	Rohnert Park & Sonoma County Water Agency	2011-2014	Continued poor habitat conditions for native warm water and coldwater fisheries. Salmonid passage difficult at low and high flows. Detriment to habitat and fish passage. Continued non-native energy inputs (leaf drop, runoff, root-zone interactions) from stream side vegetation. Water quality improvements not realized that result from native plantings and strategic sediment removal. Increased flood	Decrease operational costs associated with continued in-stream sediment removal. Reduce downstream sediment in Laguna de Santa Rosa and lower Russian River and siltation impacts on waterways interconnected with Copeland Creek. Improved habitat conditions for warm and cold water fisheries. Healthier invertebrate populations resulting from native energy inputs. Improved water quality conditions resulting from development of a thalweg,	Based on last major sediment removal project in Copeland Creek.	

Project Benefit Narrative Table						
Benefit Type	Beneficiary	When Benefits will be Received	Estimates of Without-Project Conditions	Estimates of With-Project Conditions	Description of Methods Used to Estimate	Other: Adverse Effects, Uncertainty of the Benefits, Statewide Benefits
			potential.	closed canopy, and improved riparian buffer filtering (native vegetation filtering runoff before it enters the channel)		
Habitat Restoration with Invasive Plant Removal	Rohnert Park & Sonoma County Water Agency	20011-2014	Reduced habitat enhancement and restoration for riparian and aquatic species with continued poor out migration and passage conditions for salmonids.	Closing canopy will decrease operational costs associated with vegetation management. Establishing focused sediment collection areas will decrease cost associated with sediment removal. Improve fish habitat and wildlife habitat and passage by creating and enhancing riparian habitat	Based on outcomes of similar projects in other parts of county.	

Water Quality Benefits for Impaired Water Bodies and Sensitive Habitats Worksheet					
Benefit Type	Number of downstream water bodies affected	Water body names	Beneficial uses* for the water bodies affected by the Project	The change in the beneficial-use* activity for the affected portion of the water body	The total load reduction of pollutants in the affected water body
Sediment Reduction	**One**	**Laguna de Santa Rosa**	Reducing sediment in Copeland Creek will result in less sediment in the Laguna.	Full effect not realized until construction of detention basins.	Requires further study
Habitat Restoration with Invasive Plant Removal	**One**	**Laguna de Santa Rosa**	Improve water quality and moderate temperatures to improve migratory corridor for various species.	Reduce invasive plant species including ludwigia by decreasing downstream movement of plants.	Requires further study
Flood Control and Increased Storm Water Detention	**One**	**Laguna de Santa Rosa**	Attenuated peak flows from storm water detention in Copeland Creek.	Some incremental flood control until construction of detention basins.	Requires further study

Project Title: Copeland Creek Enhancement and Restoration Project: Detention and Recharge Basins - Sonoma County Water Agency and Team Partners

Table 6 - Total Project Budget - All Project Elements

	Budget Category	(a) Non-State Share* (Funding Match)	(b) Requested Grant Funding	(c) Total *This field will fill automatically*	(d) % Funding Match *This field will fill automatically*	(e) Other Leveraged State Funds Being Used	(f) Total Project Cost including Other Leveraged State Funding
(a)	Direct Project Administration Costs	$180,648		$180,648	2%	$82,170	$262,818
(b)	Land Purchase/Easement	$2,583,775		$2,583,775	22%	$0	$2,583,775
(c)	Planning/Design/Engineering/ Environmental Documentation	$506,951	$94,821	$601,772	4%	$808,372	$1,410,144
(d)	Construction/Implementation	$1,905,171	$5,322,500	$7,227,671	16%	$805,118	$8,032,789
(e)	Environmental Compliance/ Mitigation/Enhancement	$38,480		$38,480	0%	$0	$38,480
(f)	Construction Administration	$679,992		$679,992	6%	$0	$679,992
(g)	Other Costs - Project Performance Monitoring/Data Management	$50,429	$50,429	$100,858	0%	$0	$100,858
(h)	Construction/Implementation Contingency	$54,554	$532,250	$586,804	0%	$83,333	$670,137
(i)	**Grand Total (Sum rows (a) through (h) for each column)**	**$6,000,000**	**$6,000,000**	**$12,000,000**	**50%**	**$1,778,993**	**$13,778,993**

***List sources of funding:** *Use as much space as required.*

Other Funding Sources

See Sheet Row (d) Construction/Implementation for Additional Backup Documentation for Leveraged and Match Funds

(a) **Proposition 84 Implementation Round 1Funds and Sonoma County Water Agency Match to those funds are leveraged funds and are not counted toward the match.**

(i)	Leveraged Proposition 84 Funds	**Total Cost**	$1,000,000	Total	
(ii)	Leveraged Sonoma County Water Agency Match Funds	**Total Cost**	$333,333	$1,333,333	
(b)	**Caltrans Environmental Enhancement and Mitigation Funds and Sonoma County Water Agency Match to those funds are leveraged funds and are not counted toward**				
(i)	Leveraged Caltrans Funds	**Total Cost**	$345,580		
(ii)	Leveraged Sonoma County Water Agency Match Funds	**Total Cost**	$100,080	$445,660	$1,778,993
(c)	**Federal Transportation Enhancement Match Funds**				
(i)	US DOT FHA	**Total Cost**	$669,675		
(ii)	City of Rohnert Park Match Funds	**Total Cost**	$81,000	$750,675	
(d)	**Sonoma County Agricultural Preservation and Open Space District (SCAPOSD) Match Funds**				
(i)	SCAPOSD	**Total Cost**	$711,270		
(ii)	City of Rohnert Park Match Funds	**Total Cost**	$717,280		
(iii)	Sonoma State University	**Total Cost**	$1,837		
(iv)	Sonoma County Regional Parks	**Total Cost**	$ -		
(v)	Sonoma County Public Works and Transportation Department	**Total Cost**	$ -	$1,430,387	
(e)	**Proposition 1E Funding**				
(f)	Project Team Match Funds - Habitat Restoration	**Total Cost**	$404,313		
	Project Team Match Funds - Final Design & Construct SWFM Basins	**Total Cost**	$844,625	$1,248,938	
	Land Value		$ 2,570,000	$ 2,570,000	
		Prop 1E Match		$6,000,000	
		Leveraged Funds		$1,778,993	

Federal Transportation Enhancement Match Funds

Table 6 - Total Project Budget					
	Budget Category	**(a)**	**(b)**	**(c)**	**(d)**
		Non-State Share* (Funding Match)	**Requested Grant Funding**	**Total** *This field will fill automatically*	**% Funding Match** *This field will fill automatically*
(a)	Direct Project Administration Costs	$0	$0	$0	0%
(b)	Land Purchase/Easement	$0	$0	$0	0%
(c)	Planning/Design/Engineering/ Environmental Documentation	$81,000	$69,580	$150,580	11%
(d)	Construction/Implementation	$0	$545,541	$545,541	0%
(e)	Environmental Compliance/ Mitigation/Enhancement	$0	$0	$0	0%
(f)	Construction Administration	$0	$0	$0	0%
(g)	Other Costs - Project Performance Monitoring/Data Management	$0	$0	$0	0%
(h)	Construction/Implementation Contingency	$0	$54,554	$54,554	0%
(i)	**Grand Total (Sum rows (a) through (h) for each column)**	**$81,000**	**$669,675**	**$750,675**	**11%**

Sonoma County Agricultural Preservation and Open Space District (SCAPOSD) Match Funds

Table 6 - Total Project Budget					
	Budget Category	**(a)**	**(b)**	**(c)**	**(d)**
		Non-State Share* (Funding Match)	**Requested Grant Funding**	**Total** *This field will fill automatically*	**% Funding Match** *This field will fill automatically*
(a)	Direct Project Administration Costs	$0	$0	$0	0%
(b)	Land Purchase/Easement	$13,775	$0	$13,775	1%
(c)	Planning/Design/Engineering/ Environmental Documentation	$0	$151,130	$151,130	0%
(d)	Construction/Implementation	$641,220	$490,600	$1,131,820	45%
(e)	Environmental Compliance/ Mitigation/Enhancement	$0	$0	$0	0%
(f)	Construction Administration	$64,122	$69,540	$133,662	4%
(g)	Other Costs - Project Performance Monitoring/Data Management	$0	$0	$0	0%
(h)	Construction/Implementation Contingency	$0	$0	$0	0%
(i)	**Grand Total (Sum rows (a) through (h) for each column)**	**$719,117**	**$711,270**	**$1,430,387**	**50%**

Proposition 1E Funding **Habitat Restoration**

Table 6 - Total Project Budget					
	Budget Category	**(a)**	**(b)**	**(c)**	**(d)**
		Non-State Share* (Funding Match)	**Requested Grant Funding**	**Total** *This field will fill automatically*	**% Funding Match** *This field will fill automatically*
(a)	Direct Project Administration Costs	$82,928	$0	$82,928	19%
(b)	Land Purchase/Easement	$0	$0	$0	0%
(c)	Planning/Design/Engineering/ Environmental Documentation	$0	$0	$0	0%
(d)	Construction/Implementation	$227,810	$0	$227,810	53%
(e)	Environmental Compliance/ Mitigation/Enhancement	$0	$0	$0	0%
(f)	Construction Administration	$68,360	$0	$68,360	16%
(g)	Other Costs - Project Performance Monitoring/Data Management	$25,215	$25,215	$50,429	6%
(h)	Construction/Implementation Contingency	$0	$0	$0	0%
(i)	**Grand Total (Sum rows (a) through (h) for each column)**	**$404,313**	**$25,215**	**$429,527**	**94%**

Proposition 1E Funding **Detention and Recharge Basins**

Table 6 - Total Project Budget					
	Budget Category	**(a)**	**(b)**	**(c)**	**(d)**
		Non-State Share* (Funding Match)	**Requested Grant Funding**	**Total** *This field will fill automatically*	**% Funding Match** *This field will fill automatically*
(a)	Direct Project Administration Costs	$97,720	$0	$97,720	1%
(b)	Land Purchase/Easement	$2,570,000	$0	$2,570,000	27%
(c)	Planning/Design/Engineering/ Environmental Documentation	$205,241	$94,821	$300,062	2%
(d)	Construction/Implementation	$0	$5,322,500	$5,322,500	0%
(e)	Environmental Compliance/ Mitigation/Enhancement	$38,480	$0	$38,480	0%
(f)	Construction Administration	$477,970	$0	$477,970	5%
(g)	Other Costs - Project Performance Monitoring/Data Management	$25,215	$25,215	$50,429	0%
(h)	Construction/Implementation Contingency	$0	$532,250	$532,250	0%
(i)	**Grand Total (Sum rows (a) through (h) for each column)**	**$3,414,625**	**$5,974,786**	**$9,389,411**	**36%**

Project Title: Copeland Creek Enhancement and Restoration Project: Detention and Recharge Basins - Sonoma County Water Agency and Team Partners

Note: Because benefits assoicated with all project elements except the storm water detention basins are either unquantifiable or expected to be small, only costs and benefits associated with the stormwater detention basins have been tabulated.

Tables 10 and 14 – Annual Cost of Flood Damage Reduction Project/Water Supply Project
(All costs should be in 2009 Dollars)

	Initial Costs	Operations and Maintenance Costs							
YEAR	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
	Total Project Budget (row (i), Total column)	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) + (b)+…(f)	Discount Factor	Discounted Costs (g) x (h)
2009							$0	1.000	$0
2010			Sed/ channel mods	Detention Basins	Veg Replacement		$0	0.943	$0
2011		$ 2,000	$ 50,000				$52,000	0.89	$46,280
2012	$ 938,941	$ 2,000	$ 50,000				$990,941	0.84	$832,390
2013	$ 2,816,823	$ 2,000	$ 50,000				$2,868,823	0.792	$2,272,108
2014	$ 5,633,646	$ 2,000	$ 50,000				$5,685,646	0.747	$4,247,178
2015		$ 3,200	$ 50,000	$ 30,000			$83,200	0.705	$58,656
2016		$ 3,200	$ 50,000	$ 30,000			$83,200	0.665	$55,328
2017		$ 3,200	$ 50,000	$ 30,000			$83,200	0.627	$52,166
2018		$ 3,200	$ 50,000	$ 30,000			$83,200	0.592	$49,254
2019		$ 4,000	$ 50,000	$ 30,000	$ 20,000		$104,000	0.558	$58,032
2020		$ 3,200	$ 50,000	$ 30,000			$83,200	0.527	$43,846
2021		$ 3,200	$ 50,000	$ 30,000			$83,200	0.497	$41,350
2022		$ 3,200	$ 50,000	$ 30,000			$83,200	0.469	$39,021
2023		$ 3,200	$ 50,000	$ 30,000			$83,200	0.442	$36,774
2024		$ 3,200	$ 50,000	$ 30,000			$83,200	0.417	$34,694
2025		$ 3,200	$ 50,000	$ 30,000			$83,200	0.394	$32,781
2026		$ 3,200	$ 50,000	$ 30,000			$83,200	0.371	$30,867
2027		$ 3,200	$ 50,000	$ 30,000			$83,200	0.35	$29,120
2028		$ 3,200	$ 50,000	$ 30,000			$83,200	0.331	$27,539
2029		$ 4,000	$ 50,000	$ 30,000	$ 20,000		$104,000	0.312	$32,448
2030		$ 3,200	$ 50,000	$ 30,000			$83,200	0.294	$24,461
2031		$ 3,200	$ 50,000	$ 30,000			$83,200	0.278	$23,130
2032		$ 3,200	$ 50,000	$ 30,000			$83,200	0.262	$21,798
2033		$ 3,200	$ 50,000	$ 30,000			$83,200	0.247	$20,550
2034		$ 3,200	$ 50,000	$ 30,000			$83,200	0.233	$19,386
2035		$ 3,200	$ 50,000	$ 30,000			$83,200	0.22	$18,304
2036		$ 3,200	$ 50,000	$ 30,000			$83,200	0.207	$17,222
2037		$ 3,200	$ 50,000	$ 30,000			$83,200	0.196	$16,307
2038		$ 3,200	$ 50,000	$ 30,000			$83,200	0.185	$15,392
2039		$ 4,000	$ 50,000	$ 30,000	$ 20,000		$104,000	0.174	$18,096
2040		$ 3,200	$ 50,000	$ 30,000			$83,200	0.164	$13,645
2041		$ 3,200	$ 50,000	$ 30,000			$83,200	0.155	$12,896
2042		$ 3,200	$ 50,000	$ 30,000			$83,200	0.146	$12,147
2043		$ 3,200	$ 50,000	$ 30,000			$83,200	0.138	$11,482
2044		$ 3,200	$ 50,000	$ 30,000			$83,200	0.13	$10,816
2045		$ 3,200	$ 50,000	$ 30,000			$83,200	0.123	$10,234
2046		$ 3,200	$ 50,000	$ 30,000			$83,200	0.116	$9,651
2047		$ 3,200	$ 50,000	$ 30,000			$83,200	0.109	$9,069
2048		$ 3,200	$ 50,000	$ 30,000			$83,200	0.103	$8,570
2049		$ 4,000	$ 50,000	$ 30,000	$ 20,000		$104,000	0.097	$10,088

Tables 10 and 14 – Annual Cost of Flood Damage Reduction Project/Water Supply Project (All costs should be in 2009 Dollars)									
	Initial Costs	Operations and Maintenance Costs							
YEAR	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
	Total Project Budget (row (i), Total column)	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) + (b)+…(f)	Discount Factor	Discounted Costs (g) x (h)
2050		$ 3,200	$ 50,000	$ 30,000			$83,200	0.092	$7,654
2051		$ 3,200	$ 50,000	$ 30,000			$83,200	0.087	$7,238
2052		$ 3,200	$ 50,000	$ 30,000			$83,200	0.082	$6,822
2053		$ 3,200	$ 50,000	$ 30,000			$83,200	0.077	$6,406
2054		$ 3,200	$ 50,000	$ 30,000			$83,200	0.073	$6,074
2055		$ 3,200	$ 50,000	$ 30,000			$83,200	0.069	$5,741
2056		$ 3,200	$ 50,000	$ 30,000			$83,200	0.065	$5,408
2057		$ 3,200	$ 50,000	$ 30,000			$83,200	0.061	$5,075
2058		$ 3,200	$ 50,000	$ 30,000			$83,200	0.058	$4,826
2059		$ 4,000	$ 50,000	$ 30,000	$ 20,000		$104,000	0.054	$5,616
2060		$ 3,200	$ 50,000	$ 30,000			$83,200	0.051	$4,243
2061		$ 3,200	$ 50,000	$ 30,000			$83,200	0.048	$3,994
2062		$ 3,200	$ 50,000	$ 30,000			$83,200	0.046	$3,827
2063		$ 3,200	$ 50,000	$ 30,000			$83,200	0.043	$3,578
2064		$ 3,200	$ 50,000	$ 30,000			$83,200	0.041	$3,411
Project Life									
								Total Present Value of Discounted Costs (Sum of Column (i))	$8,402,992

Project Title: Copeland Creek Enhancement and Restoration Project: Detention and Recharge Basins - Sonoma County Water Agency and Team Partners

From FRAM Model:

	Table 12 – Present Value of Expected Annual Damage Benefits Project		
(a)	Expected Annual Damage Without Project		$ 1,533,091
(b)	Expected Annual Damage With Project		$ 665,338
(c)	Expected Annual Damage Benefit	(a) – (b)	$ 867,753
(d)	Present Value Coefficient		15.76
(e)	Present Value of Future Benefits Transfer to column (e) Table 20: Proposal Project Costs and Benefits Summary.	(c) x (d)	$ 13,675,787

Summary of Cost-Benefit Analysis

Return to Menu

Project Name: **The Copeland Creek Watershed Storm Water Detention, Groundwater Recharge, Habitat R**

Description: 1) Enhancement and restoration of riparian habitat along up to 16,000 linear feet of Copeland Creek; 2) Storm water detention of up to 200 acre-feet in two to three off-stream basins located in the alluvial fan east of Petaluma Hill Road with 150 acre-feet or more annual groundwater recharge potential, and refugia for juvenile steelhead, particularly in high storm events; 3) Increase of 75 to 90 acres of permanent preserved open space, including the upstream portion of Hinebaugh Creek and Copeland

Proposed project capital cost:	$ 9,388,341	[Note: construction costs which are assumed to occur in one year.]
Change in annual O&M costs:		[Note: the change in annual O&M costs compared to without project condit
PV of future O&M costs:	$ -	(at 6% discount rate over 50 years)
PV of future costs	$ 9,388,341	[Note: the sum of capital costs plus the PV of O&M costs.]

Benefits

	Actual	Potential	
EAD without project	$ 1,493,627	$ 1,533,091	[Note: for stormwater projects use "Potential" damage which ignores st
EAD with project	$ 656,392	$ 665,338	
Annual Benefit:	$ 837,235	$ 867,753	
PV of Future Benefits:	$ 13,196,376	$ 13,677,400	(at 6% discount rate over 50 years)

Cost-Benefit Analysis

	Actual	Potential	
Net Present Value (NPV)	$ 3,808,035	$ 4,289,059	(at 6% discount rate over 50 years)
Benefit:Cost Ratio	1.406	1.457	

NPV Sensitivity to Discount Rate:

	Actual	Potential
4%	$ 8,597,288	$ 9,252,887
5%	$ 5,896,152	$ 6,453,291
6%	$ 3,808,035	$ 4,289,059
7%	$ 2,166,122	$ 2,587,297
8%	$ 853,956	$ 1,227,301

Model Assumptions

Residential

Foundation heights

Structure Category	Foundation Height (ft)
Rural - Res: Homesteads	1.5
Rural - Other: Barns, sheds	0
Urban Res: Single story (no base)	1.1
Urban Res: Two plus story (no base)	1.1
Mobile home	2.0
Commercial: Low	1
Commercial: Medium	1
Commercial: High	1
Industrial: Low	0.5
Industrial: Medium	0.5
Industrial: High	0.5

Estimate Replacement Value (assumed proxy for depreciated value)

Structure Category	Unit Cost $/ft^2 (2)	Average Size ft^2 (1)	Construction Cost
Rural - Res: Homesteads	159	1900	302100
Rural - Other: Barns, sheds	98	4000	392000
Urban Res: Single story (no base)	159	1900	302100
Urban Res: Two plus story (no base)	155	2200	341000
Mobile home (3)	98	1180	115640
Commercial: Low	120		0
Commercial: Medium	142		0
Commercial: High	207		0
Industrial: Low	120		0
Industrial: Medium	142		0
Industrial: High	207		0

1. Residential Square Footage Source: Sacramento County Tax Assessor Unit Cost and Commercial/Industrial/Public Square Footage Assumptions Source: Saylor Publications, Inc, 2007 Current Construction Costs

2. Replacement unit cost per square foot reflects average costs in the San Franci

3. According to FEMA guidance, replacement costs per square foot for mobile homes and barns and outbuildings are similar.

Other

External damages garden/outdoor areas $/building	$ 5,000
Cleanup $/building	$ 4,000
Number of residents per residential property	2.6

Commercial / Industrial Buildings

Clean-up costs as a percentage of direct structural damages	30%

Calculation of Other Direct Damages

Percentage of residential direct damages applied as indirect:	25%
Percentage of comm/ind. direct damages applied as indirect:	25%
HEC-FIA only: Percentage all building direct damages applied as indirect	25%
Percentage of roads direct damages applied as indirect:	25%

NPV Calculation

Discount Rate	6%
Time Horizon	50 years

Roads

Cost per mile of highway road inundate	$ 250,000
Cost per mile of major road inundated	$ 100,000
Cost per mile of minor road inundated	$ 30,000
Cost per mile of unsealed road inundated	$ 10,000

Agricultural Damages

	Weighted, Average Annual Damages ($/acre)	Establishment Costs ($/acre)	Land Cleanup & rehabilitation ($/acre)	Total <5 d) ($/acre)	Total (>=5 d) ($/acre)
Corn	$48	$0	$246	$293	$293
Rice	$227	$0	$243	$471	$471
Walnuts	$585	$5,284	$243	$828	$6,112
Almonds	$1,618	$3,514	$243	$1,862	$5,376
Cotton	$301	$0	$246	$547	$547
Tomatoes	$1,015	$0	$235	$1,250	$1,250
Wine Grapes	$3,241	$3,240	$235	$3,476	$6,716
Alfalfa	$250	$246	$243	$493	$739
Pasture	($15)	$82	$272	$257	$339
Safflower	$164	$0	$241	$405	$405
Sugar Beets	$313	$0	$262	$575	$575
Beans	$111	$0	$246	$356	$356
Other	$0	0	$246	$246	$246

Source: Comp Study

Establishment Costs are 50% costs of total establishment costs

Calculation of Actual to Potential Damages Ratio

		Without Project						With Project					
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Warning Time:	hours	0	0	0	0	0	0	0	0	0	0	0	0
Recent Flood Expe	Y / N	Y	Y	N	N	N	0	Y	Y	N	N	N	0
Actual : Potential Ratio		0.8	0.8	0.9	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.9	0.9

Warning Time	Experienced Community	Inexperienced Community
< 2 hours	0.8	0.9
2-12 hours	Linear reduction from 0.8 at 2 hours to 0.4 at 12 hours	0.8
>12 hours	0.4	0.7

Occ_Name	Cat_Name	Occ_Description	Parameter	Depth (ft) above First Finished Floor (FFE)																												
1ST-NB	RES	one story, no basement	Stage	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16										
1ST-NB	RES		S	0	2.5	13.4	23.3	32.1	40.1	47.1	53.2	58.6	63.2	67.2	70.5	73.2	75.4	77.2	78.5	79.5	80.2	80.7										
1ST-NB	RES		C	0	2.4	8.1	13.3	17.9	22	25.7	28.8	31.5	33.8	35.7	37.2	38.4	39.2	39.7	40	40	40	40										
2ST-NB	RES	two or more stories, no basement	Stage	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16										
2ST-NB	RES		S	0	3	9.3	15.2	20.9	26.3	31.4	36.2	40.7	44.9	48.8	52.4	55.7	58.7	61.4	63.8	65.9	67.7	69.2										
2ST-NB	RES		C	0	1	5	8.7	12.2	15.5	18.5	21.3	23.9	26.3	28.4	30.3	32	33.4	34.7	35.6	36.4	36.9	37.2										
FARM	FAR	Farm Homesteads	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25										
FARM	FAR		S	0	0	0	0	4	9	13	18	22	27	31	35	38	49	49	49	49	49	49										
FARM	FAR		C	0	0	0	0	0	6	30	54	69	75	78	80	80	80	100	100	100	100	100										
MOBILE	MOB	Mobile homes	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25										
MOBILE	MOB		S	0	0	0	0	8	44	63	73	78	80	81	82	82	82	82	82	82	82	82										
MOBILE	MOB		C	0	0	0	0	0	27	49	64	70	76	78	79	81	83	83	83	83	83	83										
PUBLIC	PUB	Public buildings	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25										
PUBLIC	PUB		S	0	0	0	0	8	22	30	35	39	41	44	46	48	49	49	49	49	49	49										
PUBLIC	PUB		C	0	0	0	0	0	17.5	25	30	34	37	39	40.5	41.5	42	42	42	42	42	42										
INDUSTRY	IND	Industrial Buildings	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25										
INDUSTRY	IND		S	0	0	0	0	4	9	13	18	22	27	31	35	38	49	49	49	49	49	49										
INDUSTRY	IND		C	0	0	0	0	0	72	75	76.5	78	81	84	87	90	96	102	108	114	120	120										
COMMERC	COM	Commercial Buildings	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25										
COMMERC	COM		S	0	0	0	0	4	9	13	18	22	27	31	35	38	49	49	49	49	49	49										
COMMERC	COM		C	0	0	0	0	0	11	30	54	69	75	78	80	80	80	100	100	100	100	100										

NOT USED

SL-NB	RES	split level, no basement	Stage	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16										
SL-NB	RES		S	0	6.4	7.2	9.4	12.9	17.4	22.8	28.9	35.5	42.3	49.2	56.1	62.6	68.6	73.9	78.4	81.7	83.8	84.4										
SL-NB	RES		SN	0	2.9	2.1	1.9	1.9	2	2.2	2.4	2.7	3.2	3.8	4.5	5.3	6	6.7	7.4	7.9	8.3	8.7										
SL-NB	RES		C	0	2.2	2.9	4.7	7.5	11.1	15.3	20.1	25.2	30.5	35.7	40.9	45.8	50.2	54.1	57.2	59.4	60.5	60.5										
SL-NB	RES		CN	0	2.2	1.5	1.2	1.3	1.4	1.5	1.6	1.8	2.1	2.5	3	3.5	4.1	4.6	5	5.4	5.7	6										
SL-NB	RES		Struct	N		0.8																										
1ST-B	RES	one story, with basement	Stage	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
1ST-B	RES		S	0	0	0.7	0.8	2.4	5.2	9	13.8	19.4	25.5	32	38.7	45.5	52.2	58.6	64.5	69.8	74.2	77.7	80.1	81.1	81.1	81.1	81.1	81.1	81.1			
1ST-B	RES		SN	0	0	1.34	1.06	0.94	0.91	0.88	0.85	0.83	0.85	0.96	1.14	1.37	1.63	1.89	2.14	2.35	2.52	2.66	2.77	2.88	2.88	2.88	2.88	2.88	2.88			
1ST-B	RES		C	0	0.1	0.8	2.1	3.7	5.7	8	10.5	13.2	16	18.9	21.8	24.7	27.4	30	32.4	34.5	36.3	37.7	38.6	39.1	39.1	39.1	39.1	39.1	39.1			
1ST-B	RES		CN	0	1.6	1.16	0.92	0.81	0.78	0.76	0.74	0.72	0.74	0.83	0.98	1.17	1.39	1.6	1.81	1.99	2.13	2.25	2.35	2.45	2.45	2.45	2.45	2.45	2.45			
1ST-B	RES		Struct	N		0.8																										
2ST-B	RES	two or more stories, with basement	Stage	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
2ST-B	RES		S	0	1.7	1.7	1.9	2.9	4.7	7.2	10.2	13.9	17.9	22.3	27	31.9	36.9	41.9	46.9	51.8	56.4	60.8	64.8	68.4	71.4	73.7	75.4	76.4	76.4			
2ST-B	RES		SN	0	2.7	2.7	2.11	1.8	1.66	1.56	1.47	1.37	1.32	1.35	1.5	1.75	2.04	2.34	2.63	2.89	3.13	3.38	3.71	4.22	5.02	6.19	7.79	9.84	12.36			
2ST-B	RES		C	0	0	1	2.3	3.7	5.2	6.8	8.4	10.1	11.9	13.8	15.7	17.7	19.8	22	24.3	26.7	29.1	31.7	34.4	37.2	40	43	46.1	49.3	52.6			
2ST-B	RES		CN	0	0	2.27	1.76	1.49	1.37	1.29	1.21	1.13	1.09	1.11	1.23	1.43	1.67	1.92	2.15	2.36	2.56	2.76	3.04	3.46	4.12	5.08	6.39	8.08	10.15			
2ST-B	RES		Struct	N		0.8																										
SL-B	RES	split level, with basement	Stage	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
SL-B	RES		S	0	0	0	2.5	3.1	4.7	7.2	10.4	14.2	18.5	23.2	28.2	33.4	38.6	43.8	48.8	53.5	57.8	61.6	64.8	67.2	68.8	69.3	69.3	69.3	69.3			
SL-B	RES		SN	0	0	0	1.8	1.6	1.5	1.6	1.6	1.6	1.6	1.7	1.9	2.1	2.4	2.6	2.9	3.2	3.4	3.6	3.9	4.2	4.8	5.7	5.7	5.7	5.7			
SL-B	RES		C	0	0.6	0.7	1.4	2.4	3.8	5.4	7.3	9.4	11.6	13.8	16.1	18.2	20.2	22.1	23.6	24.9	25.8	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3			
SL-B	RES		CN	0	2.09	1.49	1.14	1.01	1	1.02	1.03	1.04	1.06	1.12	1.23	1.38	1.57	1.76	1.95	2.13	2.28	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44			
SL-B	RES		Struct	N		0.8																										

Residential Buildings

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI:	10	50	100	0	0	0	10	50	100	0	0	0
Probability of Levee Failure	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Flood depth above ground level (ft)	0.50	0.67	0.83	0.00	0.00	0.00	0.45	0.60	0.75	0.00	0.00	0.00
Buildings Inundated (no.)												
Rural - Res: Homesteads	0	0	0	0	0	0	0	0	0	0	0	0
Rural - Other: Barns, sheds	0	0	0	0	0	0	0	0	0	0	0	0
Urban Res: Single story (no base)	0	62	263	0	0	0	0	0	31	0	0	0
Urban Res: Two plus story (no base)	0	292	1518	0	0	0	0	274	289	0	0	0
Mobile home	36	300	300	0	0	0	36	300	300	0	0	0
Structural Damages												
Rural - Res: Homesteads	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rural - Other: Barns, sheds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Urban Res: Single story (no base)	$ -	$ 327,779	$ 1,390,415	$ -	$ -	$ -	$ -	$ -	$ 163,889	$ -	$ -	$ -
Urban Res: Two plus story (no base)	$ -	$ 2,091,012	$ 10,870,398	$ -	$ -	$ -	$ -	$ 1,962,114	$ 2,069,529	$ -	$ -	$ -
Mobile home	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Structual Damages HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Structural Damages	$ -	$ 2,418,791	$ 12,260,813	$ -	$ -	$ -	$ -	$ 1,962,114	$ 2,233,418	$ -	$ -	$ -
Content Damages												
Rural - Res: Homesteads	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rural - Other: Barns, sheds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Urban Res: Single story (no base)	$ -	$ 314,667	$ 1,334,799	$ -	$ -	$ -	$ -	$ -	$ 157,334	$ -	$ -	$ -
Urban Res: Two plus story (no base)	$ -	$ 697,004	$ 3,623,466	$ -	$ -	$ -	$ -	$ 654,038	$ 689,843	$ -	$ -	$ -
Mobile home	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contents Damage HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Actual:Potential Ratio	0.8	0.8	0.9	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.9	0.9
Total Contents Damages: Actual	$ -	$ 809,337	$ 4,462,438	$ -	$ -	$ -	$ -	$ 523,230	$ 762,459	$ -	$ -	$ -
Total Contents Damages: Potential	$ -	$ 1,011,671	$ 4,958,265	$ -	$ -	$ -	$ -	$ 654,038	$ 847,177	$ -	$ -	$ -
Clean-Up/ Other Costs												
External	$ 180,000	$ 3,270,000	$ 10,405,000	$ -	$ -	$ -	$ 180,000	$ 2,870,000	$ 3,100,000	$ -	$ -	$ -
Cleanup	$ 144,000	$ 2,616,000	$ 8,324,000	$ -	$ -	$ -	$ 144,000	$ 2,296,000	$ 2,480,000	$ -	$ -	$ -
Other Costs HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Other Costs: Potential	$ 324,000	$ 5,886,000	$ 18,729,000	$ -	$ -	$ -	$ 324,000	$ 5,166,000	$ 5,580,000	$ -	$ -	$ -
Sum Actual Damages	**$ 324,000**	**$ 9,114,128**	**$ 35,452,251**	**$ -**	**$ -**	**$ -**	**$ 324,000**	**$ 7,651,344**	**$ 8,575,877**	**$ -**	**$ -**	**$ -**
Sum Potential Damages	**$ 324,000**	**$ 9,316,462**	**$ 35,948,078**	**$ -**	**$ -**	**$ -**	**$ 324,000**	**$ 7,782,152**	**$ 8,660,595**	**$ -**	**$ -**	**$ -**
Total Actual Damage with levee failure ($):	**$ 324,000**	**$ 9,114,128**	**$ 35,452,251**	**$ -**	**$ -**	**$ -**	**$ 324,000**	**$ 7,651,344**	**$ 8,575,877**	**$ -**	**$ -**	**$ -**
Total Potential Damage with levee failure ($):	**$ 324,000**	**$ 9,316,462**	**$ 35,948,078**	**$ -**	**$ -**	**$ -**	**$ 324,000**	**$ 7,782,152**	**$ 8,660,595**	**$ -**	**$ -**	**$ -**
Indirect Actual Damage	$ 81,000	$ 2,278,532	$ 8,863,063	$ -	$ -	$ -	$ 81,000	$ 1,912,836	$ 2,143,969	$ -	$ -	$ -
Indirect Potential Damage	$ 81,000	$ 2,329,115	$ 8,987,019	$ -	$ -	$ -	$ 81,000	$ 1,945,538	$ 2,165,149	$ -	$ -	$ -

Commercial & Industrial Buildings

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI:	10	50	100	0	0	0	10	50	100	0	0	0
Probability of Levee Failure	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Commercial												
'Flood depth above ground level (ft)	0.90	1.20	1.50	0.00	0.00	0.00	0.81	1.08	1.35	0.00	0.00	0.00
low building size	0	0	0	0	0	0	0	0	0	0	0	0
medium building size	0	56000	152000	0	0	0	0	28000	70000	0	0	0
high building size	0	0	0	0	0	0	0	0	0	0	0	0
Industrial												
'Flood depth above ground level (ft)	0.90	1.20	1.50	0.00	0.00	0.00	0.81	1.08	1.35	0.00	0.00	0.00
low building size	0	0	0	0	0	0	0	0	0	0	0	0
medium building size	0	56000	140000	0	0	0	0	28000	70000	0	0	0
high building size	0	0	0	0	0	0	0	0	0	0	0	0
Structural Damages												
Commercial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ 222,656	$ 604,352	$ -	$ -	$ -	$ -	$ 111,328	$ 278,320	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Commercial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ 222,656	$ 1,252,440	$ -	$ -	$ -	$ -	$ 111,328	$ 278,320	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Structural Damages	$ -	$ 445,312	$ 1,856,792	$ -	$ -	$ -	$ -	$ 222,656	$ 556,640	$ -	$ -	$ -
Contents Damages												
Commercial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Commercial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ -	$ 10,019,520	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Actual:Potential Ratio	0.8	0.8	0.9	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.9	0.9
Total Contents Damages: Actual	$ -	$ -	$ 9,017,568	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Contents Damages: Potential	$ -	$ -	$ 10,019,520	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Clean-up/ Other Costs	$ -	$ 133,594	$ 557,038	$ -	$ -	$ -	$ -	$ 66,797	$ 166,992	$ -	$ -	$ -
Clean-Up/ Other Costs: HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sum Actual Damages	**$ -**	**$ 578,906**	**$ 11,431,398**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 289,453**	**$ 723,632**	**$ -**	**$ -**	**$ -**
Sum Potential Damages	**$ -**	**$ 578,906**	**$ 12,433,350**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 289,453**	**$ 723,632**	**$ -**	**$ -**	**$ -**
Total Damage with levee failure ($):	**$ -**	**$ 578,906**	**$ 11,431,398**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 289,453**	**$ 723,632**	**$ -**	**$ -**	**$ -**
Total Damage with levee failure ($):	**$ -**	**$ 578,906**	**$ 12,433,350**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 289,453**	**$ 723,632**	**$ -**	**$ -**	**$ -**
Indirect Actual Damages	$ -	$ 144,726	$ 2,857,849	$ -	$ -	$ -	$ -	$ 72,363	$ 180,908	$ -	$ -	$ -
Indirect Potentail Damages	$ -	$ 144,726	$ 3,108,337	$ -	$ -	$ -	$ -	$ 72,363	$ 180,908	$ -	$ -	$ -

Agricultural Damages

		Without Project						With Project					
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI:		10	50	100	0	0	0	10	50	100	0	0	0
Probability of Levee Failure		1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Length of Inundation <5d Y/N		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Agricultural Land Inundated													
Corn	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Rice	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Walnuts	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Almonds	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Cotton	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Tomatoes	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Wine Grapes	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Alfalfa	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Pasture	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Safflower	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Sugar Beets	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Beans	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Other	ac.	0	0	0	0	0	0	0	0	0	0	0	0
Potential Damages													
Corn		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rice		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Walnuts		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Almonds		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cotton		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tomatoes		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Wine Grapes		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Alfalfa		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pasture		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Safflower		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sugar Beets		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Beans		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Potential Damages		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Damage with levee failure ($):		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Roads

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI	10	50	100	0	0	0	10	50	100	0	0	0
Probability of Levee failure	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Roads Inundated												
length of arterial roads inundated (miles)	0.30	1.40	3.00	0.00	0.00	0.00	0.03	0.40	0.90	0.00	0.00	0.00
length of major roads inundated (miles)	0.80	1.30	2.30	0.00	0.00	0.00	0.60	0.70	1.10	0.00	0.00	0.00
length of minor roads inundated (miles)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
length of unsealed roads inundated (miles)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potential Damages												
length of arterial roads inundated (miles)	$ 75,000	$ 350,000	$ 750,000	$ -	$ -	$ -	$ 6,250	$ 100,000	$ 225,000	$ -	$ -	$ -
length of major roads inundated (miles)	$ 80,000	$ 130,000	$ 230,000	$ -	$ -	$ -	$ 60,000	$ 70,000	$ 110,000	$ -	$ -	$ -
length of minor roads inundated (miles)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
length of unsealed roads inundated (miles)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Damages:	*$ 155,000*	*$ 480,000*	*$ 980,000*	$ -	$ -	$ -	*$ 66,250*	*$ 170,000*	*$ 335,000*	$ -	$ -	$ -
Total Damage with levee failure ($):	$ 155,000	$ 480,000	$ 980,000	$ -	$ -	$ -	$ 66,250	$ 170,000	$ 335,000	$ -	$ -	$ -

Special Cases - Dollar Damages Incurred

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	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI	10	50	100	0	0	0	10	50	100	0	0	0
Probability of Levee failure	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Description / Site ID												
Total Damages:	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Damage with levee failure ($):	0	0	0	0	0	0	0	0	0	0	0	0

Calculation of Without Project EAD

	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Y Intercept
Average Recurrence Interval (ARI)	10	50	100	0	0	0	
AEP	0.100	0.020	0.010	#DIV/0!	#DIV/0!	#DIV/0!	0
Actual Damage to Residential Buildings ($)	$ 324,000	$ 9,114,128	$ 35,452,251	$ -	$ -	$ -	
Potential Damage to Residential Buildings ($)	$ 324,000	$ 9,316,462	$ 35,948,078	$ -	$ -	$ -	
Actual Damage to Commercial/Industrial Buildings ($)	$ -	$ 578,906	$ 11,431,398	$ -	$ -	$ -	
Potential Damage to Commercial/Industrial Buildings ($)	$ -	$ 578,906	$ 12,433,350	$ -	$ -	$ -	
Damage to Agriculture ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Damage to Roads ($)	$ 155,000	$ 480,000	$ 980,000	$ -	$ -	$ -	
Actual Indirect Costs	$ 119,750	$ 2,543,258	$ 11,965,912	$ -	$ -	$ -	
Potential Indirect Costs	$ 119,750	$ 2,593,842	$ 12,340,357	$ -	$ -	$ -	
Special Cases	$ -	$ -	$ -	$ -	$ -	$ -	
Total Actual Damages	$ 598,750	$ 12,716,291	$ 59,829,561	$ -	$ -	$ -	$ 59,829,561
Total Potential Damages	$ 598,750	$ 12,969,209	$ 61,701,784	$ -	$ -	$ -	$ 61,701,784
EAD (Actual)	$ 1,493,627						
EAD (Potential)	$ 1,533,091						

Potential Damages

	Without Project							With Project						
Water Surface Elevation - channel (f)	0	0	0	0	0	0		0	0	0	0	0	0	
ARI	10	50	100	0	0	0		10	50	100	0	0	0	
Probability of Exceedence (AEP)	0.100	0.020	0.010	#DIV/0!	#DIV/0!	#DIV/0!		0.100	0.020	0.010	#DIV/0!	#DIV/0!	#DIV/0!	
Damages incurred	$ 598,750	$ 12,969,209	$ 61,701,784	$ -	$ -	$ -	$ 61,701,784	$ 487,813	$ 10,302,006	$ 12,149,034	$ -	$ -	$ -	$ 12,149,034

Actual Damages

	Without Project							With Project						
Water Surface Elevation - channel (f)	0	0	0	0	0	0		0	0	0	0	0	0	
ARI	10	50	100	0	0	0		10	50	100	0	0	0	
Probability of Exceedence (AEP)	0.100	0.020	0.010	#DIV/0!	#DIV/0!	#DIV/0!		0.100	0.020	0.010	#DIV/0!	#DIV/0!	#DIV/0!	
Damages incurred	$ 598,750	$ 12,716,291	$ 59,829,561	$ -	$ -	$ -	$ 59,829,561	$ 487,813	$ 10,138,497	$ 12,043,137	$ -	$ -	$ -	$ 12,043,137

Without Project

Water Surface Elevation - channel (f)	10	50	100	0	0	0
Probability of Exceedence (AEP)	0.100	0.020	0.010	0.010	0.010	0.010
Potential	$ 598,750	$ 12,969,209	$ 61,701,784	$ 61,701,784	$ 61,701,784	$ 61,701,784
Actual	$ 598,750	$ 12,716,291	$ 59,829,561	$ 59,829,561	$ 59,829,561	$ 59,829,561

With Project

Water Surface Elevation - channel (f)	10	50	100	0	0	0
Probability of Exceedence (AEP)	0.100	0.020	0.010	0.010	0.010	0.010
Potential	$ 487,813	$ 10,302,006	$ 12,149,034	$ 12,149,034	$ 12,149,034	$ 12,149,034
Actual	$ 487,813	$ 10,138,497	$ 12,043,137	$ 12,043,137	$ 12,043,137	$ 12,043,137

Calculation of With Project EAD

	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	
Average Recurrence Interval (ARI)	10	50	100	0	0	0	
AEP	0.100	0.020	0.010	#DIV/0!	#DIV/0!	#DIV/0!	0
Actual Damage to Residential Buildings ($)	$ 324,000	$ 7,651,344	$ 8,575,877	$ -	$ -	$ -	
Potential Damage to Residential Buildings ($)	$ 324,000	$ 7,782,152	$ 8,660,595	$ -	$ -	$ -	
Actual Damage to Commercial/Industrial Buildings ($)	$ -	$ 289,453	$ 723,632	$ -	$ -	$ -	
Potential Damage to Commercial/Industrial Buildings ($)	$ -	$ 289,453	$ 723,632	$ -	$ -	$ -	
Damage to Agriculture ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Damage to Roads ($)	$ 66,250	$ 170,000	$ 335,000	$ -	$ -	$ -	
Actual Indirect Costs	$ 97,563	$ 2,027,699	$ 2,408,627	$ -	$ -	$ -	
Potential Indirect Costs	$ 97,563	$ 2,060,401	$ 2,429,807	$ -	$ -	$ -	
Special Cases	$ -	$ -	$ -	$ -	$ -	$ -	
Total Actual Damages	$ 487,813	$ 10,138,497	$ 12,043,137	$ -	$ -	$ -	$ 12,043,137
Total Potential Damages	$ 487,813	$ 10,302,006	$ 12,149,034	$ -	$ -	$ -	$ 12,149,034

EAD (Actual)	$ 656,392
EAD (Potential)	$ 665,338

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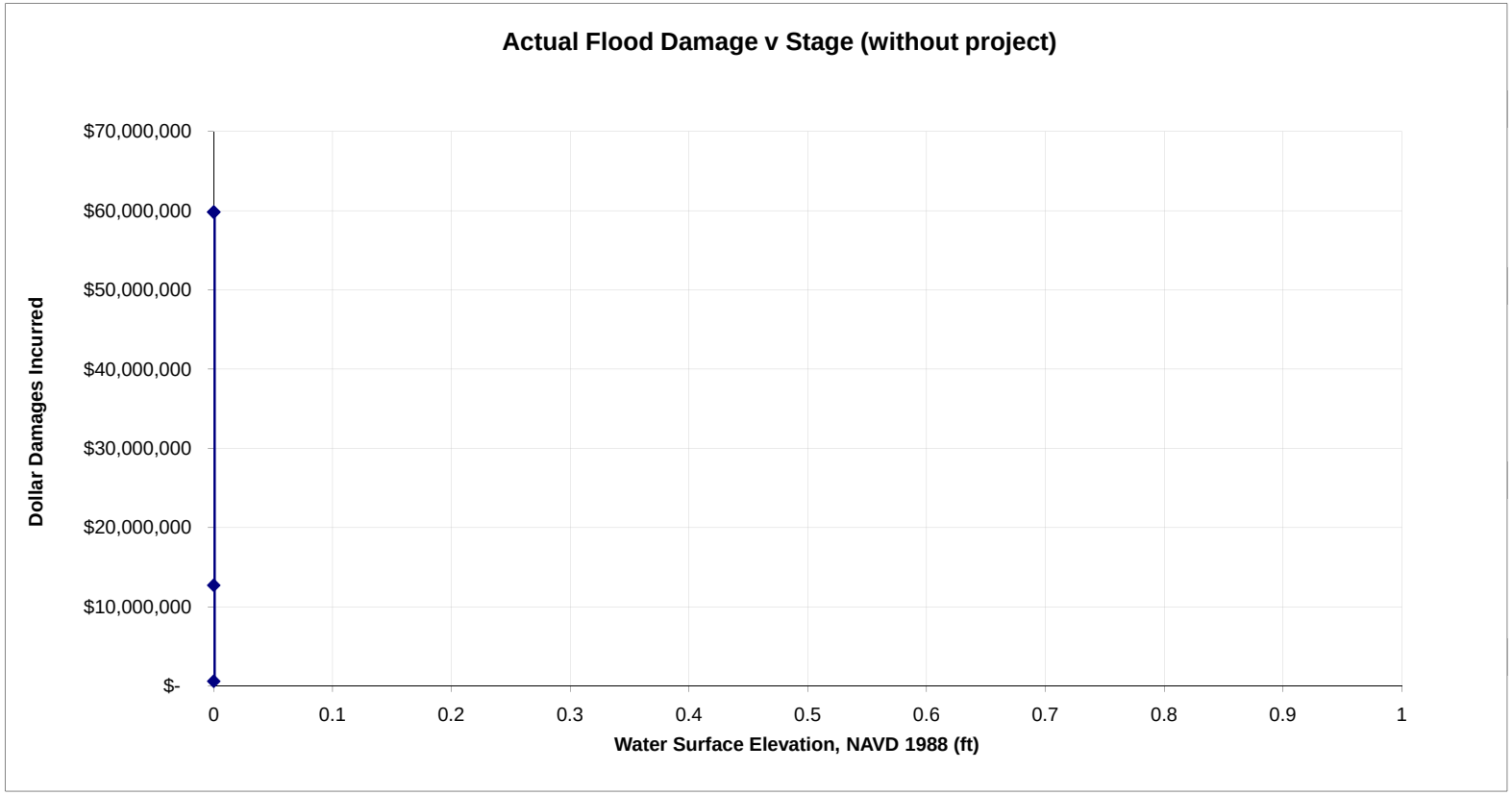

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